

CESI File Sheets - Volume 2

COUNCIL FOR ELEMENTARY SCIENCE INTERNATIONAL

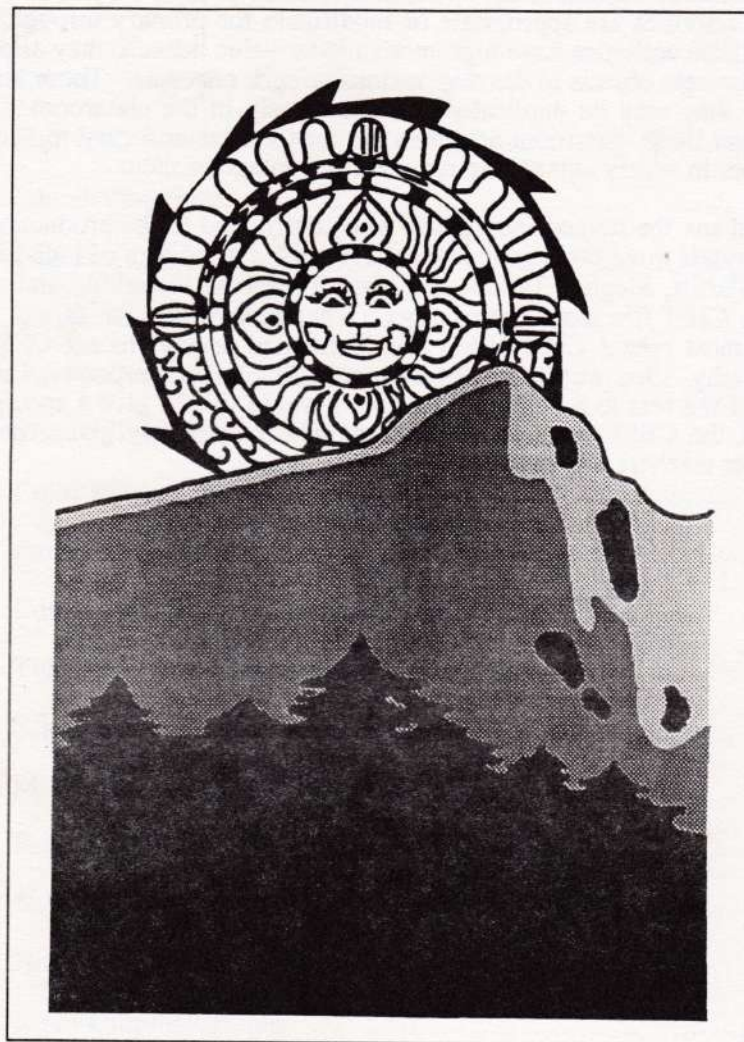


Mark R. Malone, Editor

- NSTA DIVISION AFFILIATE -

CESI File Sheets *Volume 2*

COUNCIL FOR ELEMENTARY SCIENCE INTERNATIONAL



Edited and Produced by: **Mark R. Malone**
University of Colorado at Colorado Springs

Original CESI File Sheets Written by: **CESI Members**

Original CESI File Sheets Edited by:

Philip C. Parfitt
*Chicago Museum of
Science and Industry*

Mark R. Malone
*University of Colorado
at Colorado Springs*

Mark and Meghan Twiest
*Indiana University
of Pennsylvania*

Published by: **Council for Elementary Science International**
NSTA Division Affiliate
1742 Connecticut Avenue, N.W.
Washington, DC 20009-1171

First Printing - March 1992

PREFACE

A book like *CESI File Sheets - Volume 2* is not possible without the contributions of literally dozens of individuals. The twenty five classroom activities presented in this book were originally presented at various *CESI Make and Take Workshops* by CESI members and friends. These activities are appropriate or modifiable for primary through middle school age children. These activities have high motivational value because they allow the students to manipulate concrete objects to develop various science concepts. These materials are not copyrighted, so they may be duplicated and used freely in the classroom. The materials needed to conduct these classroom activities are inexpensive and easy to acquire so that a classroom teacher in nearly any setting may take advantage of them.

I would like to thank the several individuals who contributed to the production of this book. In addition to myself three other individuals have served as editors of individual file sheets. Thanks to Phil Parfitt, Meghan Twiest, and Mark Twiest for thoughtful and clean editing of the ideas of the CESI file sheet contributors. Thanks to Bruce Smith and Lynne Kepler (editors of the most recent *CESI News*) who formatted several recent *CESI File Sheets*. Thank you to Kathy Allen who struggled with my aging and underpowered word processor to input much of the text to a common format. I would like to give a special *international* thanks to all of the CESI members and friends who have freely given their ideas to be shared with other teachers throughout the world.

- Mark R. Malone

Dedicated to:

Sue, Emmett and Cullen Malone.

*Thanks for your support
while I completed this book.*

DISCLAIMER

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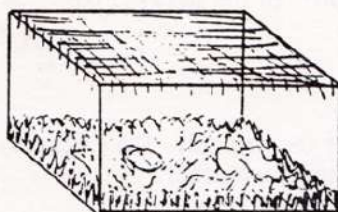
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Philip C. Parfitt, Editor

CRICKET WATCH



Crickets make great "pets" to use for animal observations in the classroom. They are definitely inexpensive and require little care. Gallon jars or fish tanks/terrariums can be used for housing.

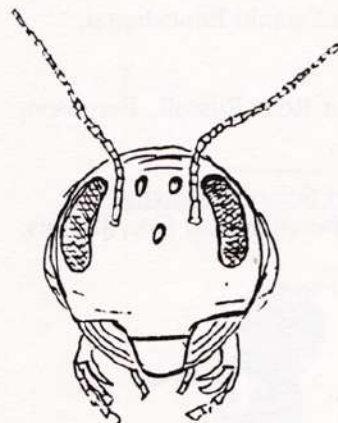
Crickets are active insects. They can jump more than thirty times their own body length. Keep the crickets at home by using screening over the top of the container. This also allows sufficient air circulation.

Crickets are aggressive towards each other. The terrarium should offer hiding places for them. Broken egg cartons or cardboard tubes work well.



Open water is not necessary in the terrarium. Crickets can obtain the water they need from pieces of fruit or vegetable such as potato or apple. Their main diet, however, should be dry rolled oats or bran.

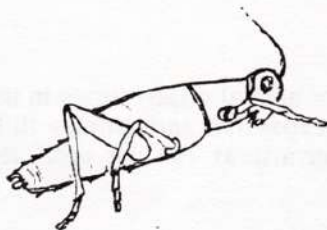
The terrarium should contain both males and females if you intend to have the cricket family continue. Crickets live on dry soil but females need moist soil to lay the eggs. A small cup of soil planted in the dry soil of the terrarium can be watered without wetting the entire bottom.



Cricket Watch

During your "cricket watch," look carefully at the crickets.

1. Do all the crickets have wings? How many wings? How can you tell?
2. How are their bodies put together? Do they seem to have different pieces? To which piece are the legs attached?
3. How do they move their antennae? Make a list of words to describe their movement.
4. How many legs do they have? Look carefully at a leg under a magnifying glass. What does it look like? Does it have parts? Draw a leg. Are there any crickets with missing legs? How do they get around?



5. If you were making a model of a cricket, what color would you use? What materials? Make some models.
6. Where do the crickets seem to stay most of the time? Any ideas why? How do they act if you move the terrarium?
7. How much food do crickets eat? How many different foods do they eat? Try small amounts of different foods.
8. How do crickets act in the light? In the dark? Plan some experiments to find out.
9. Do crickets sleep?
10. Can you imitate the sounds of the cricket? Do crickets communicate? What do they tell each other?

Insects can be fun. The fear of insects generated by insecticide companies and horror movies is unrealistic. Life on earth would cease without insects. Insects can be your best classroom pets being easy to house, easy to maintain, clean and odorless, and inexpensive. Most are safe and can offer exciting activities for animal behavior studies.

References:

1. Insect Pets: Catching Them and Caring for Them, Carla Stevens, Greenwillow, New York, 1978.
2. Insect's Body, Joanna Cole, Morrow, New York, 1984.
3. Minibeasts, Science 5/13, MacDonald Educational, New York, 1973.
4. Ten-minute Field Trips, Helen Ross Russell, Ferguson, Chicago, 1973.
5. The Whole Cosmos Catalog of Science Activities, Abruscato & Hassard, Scott, Foreman and Co., Illinois, 1977.

Submitted by: Elizabeth Royston

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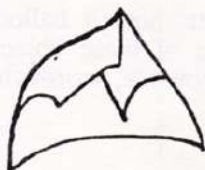
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Philip C. Parfitt, Editor

SIMPLE AERODYNAMICS

Take a plain sheet of 8 1/2 x 11 inch paper, hold it between two fingers and drop it. Does it fall straight to the ground? No! It falls catching the air, rocking back and forth with little predictability. It is unstable.

Now take this same sheet of paper and cut it 1/2 way along its side-to-side center line. Overlap the edges into a cone shape and fasten the edges. Now try dropping this object. Does it fall the same way every time?

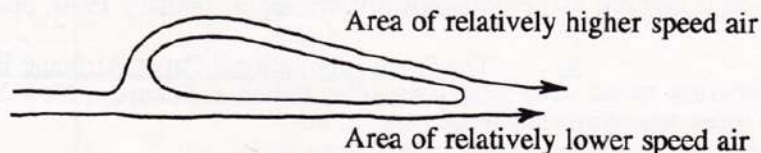


This object is stable. It will fall nose down no matter how it is dropped.

Now take this cone and another sheet of paper, hold the two at the same height and drop them together. Which one hit the floor first? The Cone! It has less air resistance than the sheet of paper. If you have ever been in a strong wind, you have felt the pressure of air resistance.

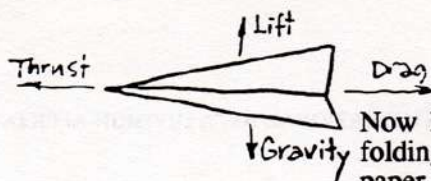
Airplanes, both real and paper, have to travel through the air. To do so efficiently, they are shaped so that air resistance or drag is minimized and as a result stability is increased.

But why do airplanes fly? Airplane wings are designed to give an airplane lift. Lift is an upward force on an airborne object. It is created by the wings which are shaped as an airfoil.

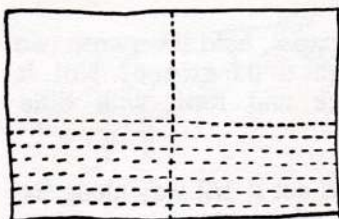


Fast moving air creates low pressure. As a result this low pressure creates lift on the wing. To see this, hold a piece of paper to your chin. Blow over the top of the sheet of paper. The paper will rise. The fast moving air over the top of the paper causes lift.

Airplanes have four basic forces which affect flight. They are lift, drag, gravity, and thrust. These are the directions in which each force occurs.



Now let's build an airplane called the flying wing. Start by folding a 8 1/2 x 11 inch sheet of paper width-wise. Divide the paper exactly with a nice sharp crease. Now open it up and make a series of 1 cm folds until you reach the center of the paper and then make one more fold. Pinch the center of all the folds so that the paper assumes a slightly V-shaped posture. It is now ready to fly!



To launch this aircraft, hold it gently by the rear of the wing. Release it carefully as you move your hand forward. Do not try to throw it hard. This plane will glide very efficiently when properly constructed.

There are hundreds of different types of aircraft that can be built with paper. There are also a wide range of activities and concepts that can be learned playing with paper airplanes. Try contests for time aloft, distance flown, and aerobatics.



Related activities include water rockets, hot air balloons, and kites. Investigating the aerodynamics of these objects along with airplanes can lead to exciting, enjoyable, worthwhile class time spent with your students.

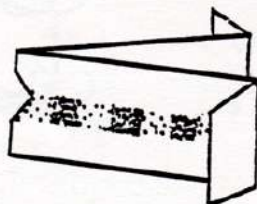
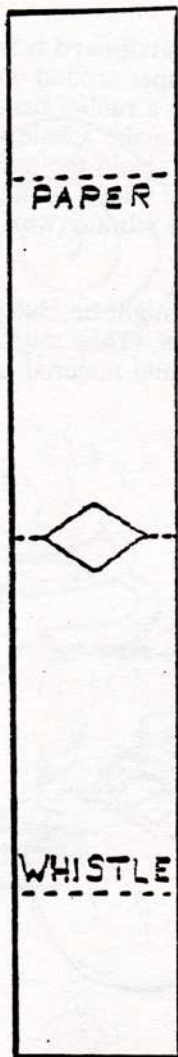
References:

1. Gliding, Soaring, and Skysailing, Norman F. Smith, Messner, New York, 1980.
2. How to Make and Fly Paper Airplanes, Ralph S. Barnaby, Four Winds Press, New York, 1968.
3. Paper Airplane Book, Seymour Simon, Viking/Puffin, New York, 1976.
4. "Paper Airplanes," Science and Children, Gerald F. Consuegra, January 1980, pp. 16-17, NSTA.
5. The Great International Paper Airplane Book, Jerry Mander, Simon & Schuster, New York, 1967.

Submitted by: Mark and Meghan Twiest

Philip C. Parfitt, Editor

SOUND-VIBRATIONS



The following are several activities you might want to do with students to demonstrate that sound is caused by vibrations. I've identified them according to the progression of difficulty and concept development that works best with my students; you may find that they work best in another order or that some are not important to meeting your students' needs.

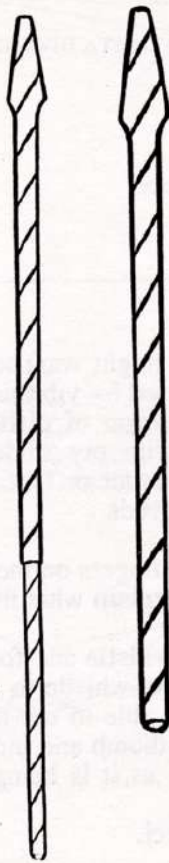
1. Ask students to gently place their fingers on their throats as they hum a tune. Have them explain what they feel.
2. Have students cut out the **paper whistle** and fold on the dotted lines. Ask them to hold the whistle to their lips and blow sharply. They will be able to see the paper vibrating. Have them place their thumb and index finger around a partner's whistle as it is being blown.

Ask them to describe what they feel.

3. Place a ruler on a flat surface with one end protruding over the edge. Push down on the edge that is extended past the surface top and release it. It will move up and down quickly and make a sound. Ask students to describe what they hear. Ask students how you might change the sound that the ruler makes. (Try extending more or less of the ruler over the edge, try a ruler made of a different material, try pushing it down further or less.)
4. Have students make **soda straw whistles**: flatten about 2 cm of one end of the straw, cut away a small triangle on each side of the flattened end, put the flat end in your mouth (be sure it is in far enough so that your lips are not touching the flat part), and blow into the straw.

Ask students what they feel.

Provide several different diameters of straws. Have students compare the sound each one makes. Ask them if a narrower straw is higher in pitch or lower in pitch than a wider straw (narrow is higher). Ask how they might change the pitch of the straws they are using (cut off the end).

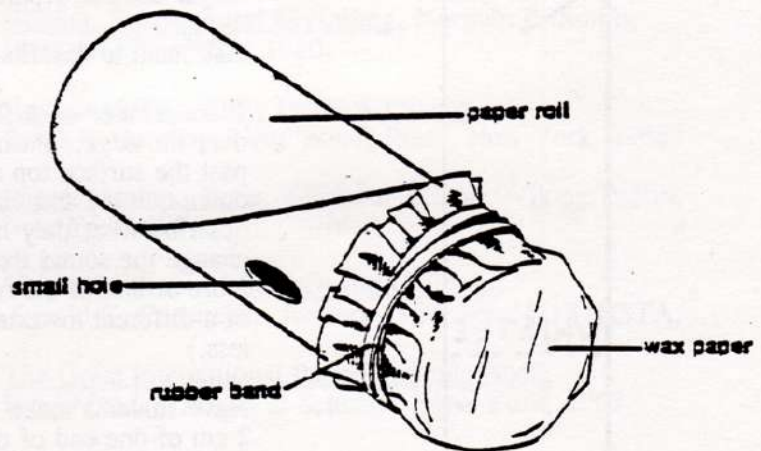


Have them place a narrow straw whistle inside a wider straw, have them move the wider straw up and down the length of the narrow straw and listen to the sounds produced. (This is similar to a trombone.)

Ask interested students to join several straws of the same diameter together (this can be done with tape or a "coupler") to make a longer straw whistle. Have them describe what they found out.

5. Instruct students in how to make a **cardboard tube kazoo**: (1) Wrap a piece of wax paper around one end of the tube and secure it tightly with a rubber band. (2) About 2 cm from the covered end, make a hole with a paper punch or a sharp pencil. (3) Hold the open end to your mouth, pucker your lips, and hum a sound. Ask students what parts of the kazoo vibrate (wax paper).

Have them identify what variables might be changed to change the sound the kazoo produces. (They might want to try length of tube, size of hole, and material used to cover the end.)



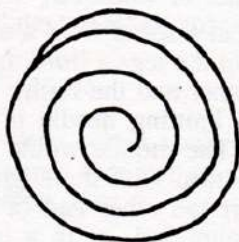
Submitted by: Linda Froschauer - Weston, CT

CESI File Sheet 29

COUNCIL FOR ELEMENTARY SCIENCE INTERNATIONAL-NSTA DIVISION AFFILIATE

Philip C. Parfitt, Editor

SNAKES



Concept:

The transfer of heat by the movement of a heated gas or liquid is called **convection**. When a gas such as air is heated unevenly, the heated part rises, producing a current of air.

Objective:

The student will make a paper snake which will squirm and slither if placed over a heat source. This will be evidence that the heated air is rising.

Procedure:

1. Draw a spiral on a sheet of paper. Make the end of the spiral a snake's head. Cut the spiral out. Foil is a good beginning material to use because it will not burn.
2. Attach a string to the tail of the snake.
3. Carefully hold the snake over a candle or other heat source. What happens to the serpent?



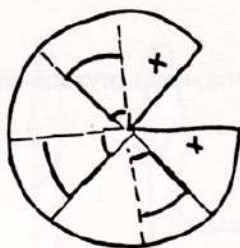
Challenge:

Can you think of other things that move when placed over heat? Design something that will move in the same way that the snake moved. How many toys can you make that will move when held over heat? Will they all look like a snake?



HEATMOBILE

When it is cold outside and you are enjoying the warm indoors, try making a **heatmobile**. You can place one over a radiator or a heater and the warm air currents will move it gently.



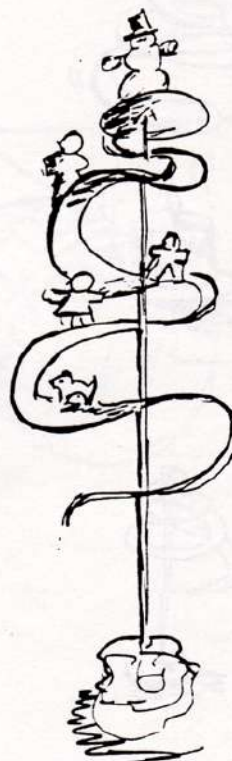
The carousel mobile is made from a circle too. The circle is divided into 8 equal pieces, and one of the pieces is cut out. Then the circle is glued, one piece marked x over the other piece marked x, leaving a cone divided in 6 parts. The carousel is placed on top of a knitting needle in the same manner as the spiral mobile. Little figures -- birds, airplanes, men, children, animals -- can be hung on it with a thread. If the mobile topples, the balance is wrong and you must move the figures along the edge until you get it right. This mobile can be hung from the ceiling, where it will turn realistically.

A favorite story or concept can be acted out on the spiral or carousel mobile.



The spiral is made from thin oak tag. Cut a spiral from a circle and cut the small figures separately. Snip the legs a little so that you can glue one leg just ahead of the other and the figure will keep in balance. Insert the point of a knitting needle in the small hole in the middle of the circle. The mobile would just perch on the needle so that it is free to turn with the slightest movement of warm air. You can insert the other end of the needle in a potato, covered with aluminum foil, or in a large cork or a wooden block.

Note: Appropriate safety precautions should be observed when using candles or other heat sources.



Karen Lind - University of Louisville

Philip C. Parfitt, Editor

TICKLE YOUR TASTEBUDS

Did you know different areas of your tongue taste different flavors? Through this activity, students will be able to locate and identify the different kinds of tastebuds on the tongue.

Materials

4 clean cotton swabs per student
4 paper cups per pair of students
lemon juice

salt
sugar
instant coffee



Procedure

Have your students draw a picture of the tongue similar to the one shown above. Place 4 paper cups, each filled with diluted amounts of sugar water, salt water, lemon juice and coffee. With students working in pairs, have one partner dip the swab in solution "A" and touch areas 1 through 5 on that person's tongue. Make sure the students don't mix swabs between different solutions or partners.

Results

1. How did your classmate think the liquid "A" tasted - sweet, sour, salty or bitter?
2. On what part of the tongue did your classmate taste the liquid?
3. On your picture of the tongue, label where liquid "A" was tasted. Label whether liquid "A" was sweet, sour, salty, or bitter.
4. Repeat steps again using the cups labeled B, C, and D.

Your students will find different flavors are detected in four different locations on the tongue. Ask the students to compile their results on a giant tongue chart on the board. Were their results similar?

This activity has a number of interesting variations. You can have the students try this activity while blindfolded or with their noses plugged.

Have your students make a list of foods they like. Which tastes were most popular? What other properties do foods exhibit?

References

Herbert, Don. Mr. Wizard's 400 Experiments in Science. Lab 500, 1983.

Keen, Martin. Let's Experiment. New York: Grosset and Dunlap, 1976.

Storey, Dawn. CESI Understanding the Healthy Body. Columbus, Ohio, SMEAC Information Reference Center, 1983, p. 49.

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COUNCIL FOR ELEMENTARY SCIENCE INTERNATIONAL-NSTA DIVISION AFFILIATE

Mark R. Malone, Editor

Science Activities for Graphing and Probability (Serving-up Skewed Rice)

These activities utilize easily found materials and easily observed events to introduce children to the concepts of probability and give them practice in gathering and graphing data. Children make simple observations, record that data, graph it and make predictions about future events based on graphs.

Materials

paper funnel
graph paper
tape
paper cup

books
rice grid
rice
12" ruler

colored marking pen
stiff cardboard

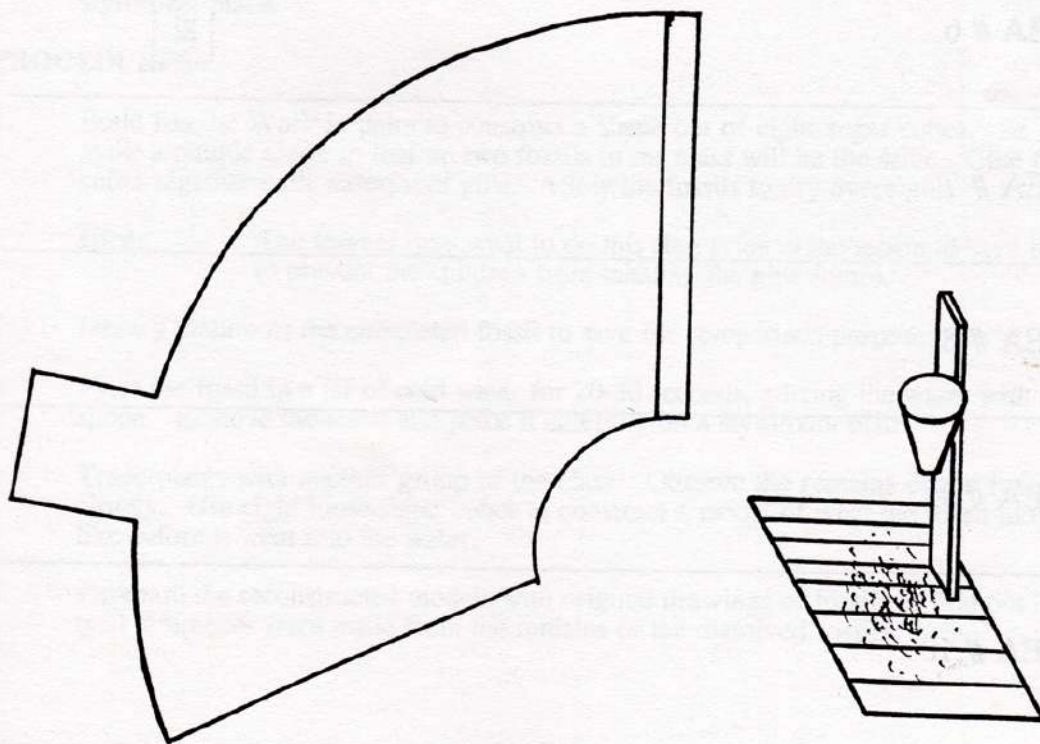
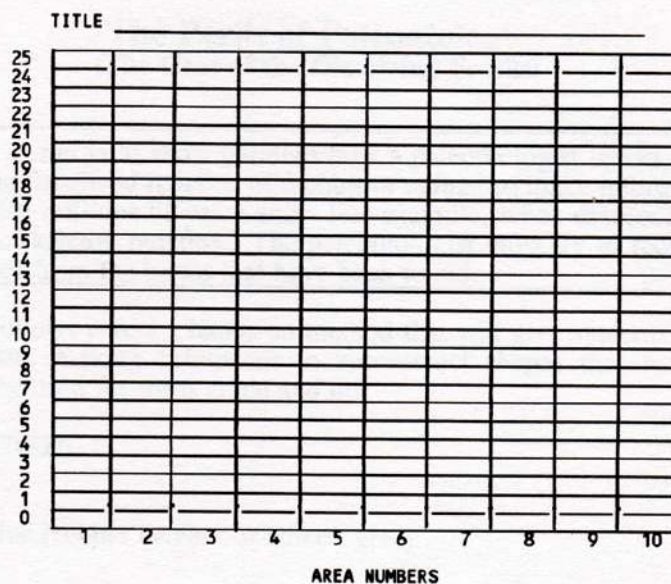
After students construct the funnel from the outline they will tape the tab at the top of the funnel to the ruler. The ruler with the funnel attached is placed vertically over the rice grid on the rectangle labeled "ruler spot". Students will count out 50 grains of rice and place them in the paper cup. Next the rice is poured through the funnel. The students will observe how the rice has scattered on the grid sheet and then count and record how many grains of rice fell into each area (1 through 10). These could be recorded directly on the histogram graphing sheet provided, or recorded and averaged over several trials before graphing. Students can easily see how the pattern on the rice grid is reflected in the graph.

There are several variations on this activity. Patterns can be observed and graphed for rice dropped from various heights on the ruler. When rice is dropped higher, the distribution tends to be much wider. The rice grid can be placed on a stiff piece of cardboard so that the angle of the surface can be adjusted by leaning it on objects such as books. With this arrangement, the histogram tends to reflect a skewed distribution of the rice.

Students should also be given opportunities to interpret the graphs and the types of distributions they form (normal and skewed distributions.) They should also be led to understand that while they can be used to predict general patterns of future events, they may not accurately reflect what happens to an individual grain of rice. With any particular arrangement of the materials the rice will form a fairly consistent pattern. By repeating an arrangement students will see that while results are similar from trial to trial, they are usually not exactly the same. However in a normal or skewed distribution, the largest number of grains fall near the mean of the distribution. Students can also be shown that while the mean is the most likely place for the grains to land, a single grain of rice can fall almost anywhere over several trials. This can be demonstrated by having students color one grain of rice with a marking pen. Students should try to predict where this one grain will land. over several trials the colored grain will land at every possible position, though it falls near the mean more often than other positions.

As a follow-up to this activity, students can collect data about members of their class, school, or home to see that other phenomena also fall into various patterns or distributions. Some bits

of information that are both easy to collect and graph are: students age to the nearest half year, the number of letters in their names, number of people living at home, height, weight, hat size, etc. By the end of the lesson students should realize that normal events fall into patterns and that those patterns are often predictable. They will also gain experience in observing, experimenting, recording data, graphing and interpreting data, and making predictions.



Submitted by: Mark R. Malone - University of Colorado

AREA # 1

AREA # 2

AREA # 3

AREA # 4

AREA # 5

AREA # 6

AREA # 7

AREA # 8

AREA # 9

AREA # 10

RULER SPOT

CESI File Sheet 32

COUNCIL FOR ELEMENTARY SCIENCE INTERNATIONAL-NSTA DIVISION AFFILIATE

Mark R. Malone, Editor

The Perils of Paleontology (The Case of the Dissolving Fossils)

The purpose of this lesson is to show children how a paleontologist works. He must use the evidence found in the fossilized remains of a plant or animal to make inferences about how the plant or animal looked millions of years ago. For example, when dinosaur bones are found, only a portion of the skeleton remains. The paleontologist must try to reconstruct the whole animal using the clues from the bones that have been found.

The activity which follows offers a hands-on method that will give students the opportunity to act as paleontologists, making inferences to reconstruct shapes that have been partially dissolved. It could be used for third grade and up.

MATERIALS NEEDED:

sugar cubes
waterproof glue (rubber cement or silicon glue)
jars of water
spoons
paper and pencils
styrofoam plates

PROCEDURES

1. Build fossils: Work in pairs to construct a shape out of eight sugar cubes. Be sure to make a unique shape so that no two fossils in the class will be the same. Glue the cubes together with waterproof glue. Allow the fossils to dry overnight.

Hint: The teacher may want to do this step prior to the lesson to save time or to prevent the children from inhaling the glue fumes.
2. Draw a picture of the completed fossil to save for comparison purposes.
3. Place the fossil in a jar of cold water for 20-30 seconds, stirring the water with a spoon. Remove the fossil and place it carefully on a styrofoam plate.
4. Trade plates with another group in the class. Observe the remains of the fossil very closely. Use eight loose sugar cubes to construct a model of what the fossil looked like before it went into the water.
5. Compare the reconstructed models with original drawings of fossils to find out how well inferences were made from the remains of the dissolved fossils.

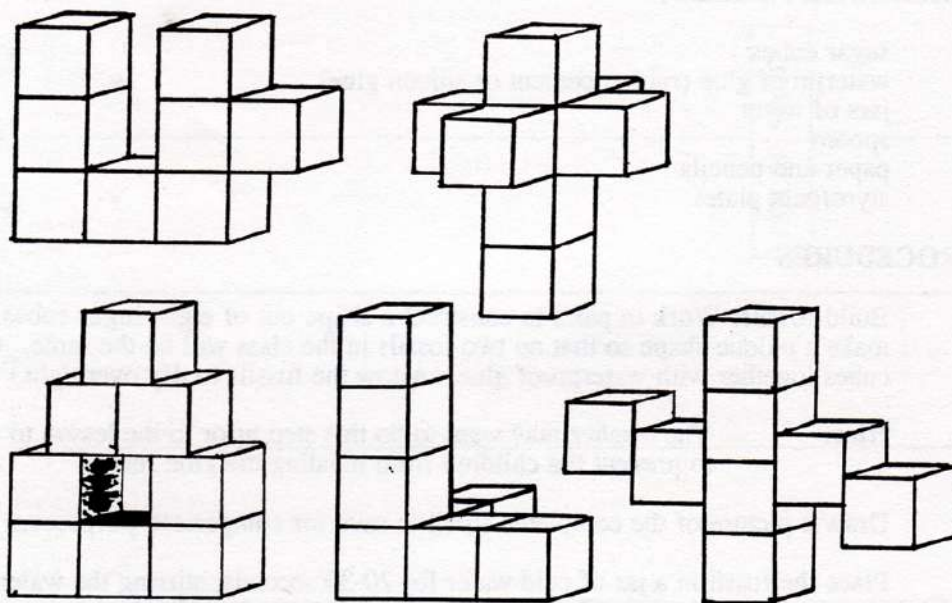
DRAWING CONCLUSIONS

The teacher might ask the following questions:

1. What clues did you find in the remaining fossils? How did you use those clues to reconstruct the original fossil?
2. How does a paleontologist use fossils to find out about the past? Is it always possible to do this? Why or Why not?
3. Does the paleontologist have a hard job to do? Why or why not?
4. What are some other situations where it is important to be able to make inferences based on available evidence?

FURTHER STUDY

The children should have the opportunity to look at real fossils and pictures of fossils to make inferences about the plants or animals from which the fossils formed.



Submitted by: Linda Wrhen

Mark R. Malone, Editor

COLOR ILLUSION WHEEL

This investigation involves spinning black and white disks that create the illusion of color for many people. The Color Illusion Wheel is sometimes called the Benham Disk. It was so named after its creator, Charles E. Benham (1806-1929), an English newspaper owner. When the disk (pictured below) is spun, most people see an illusion of colors produced. No one is quite sure why the colors appear. Speculation ranges from a sort of retinal fatigue produced by the motion, to a mechanism which is not yet understood that breaks up white light into the colors of the spectrum.

PROCEDURES

Construct a disk from posterboard or corrugated cardboard. Cover half of the disk with black construction paper and the other half with white paper. Using a pencil, ruler, and compass, lightly draw lines like the lines shown below on the white half of the disk. (See Figure 1.) Next erase the straight lines and trace over the curved lines with a black marker. (See Figure 2.)

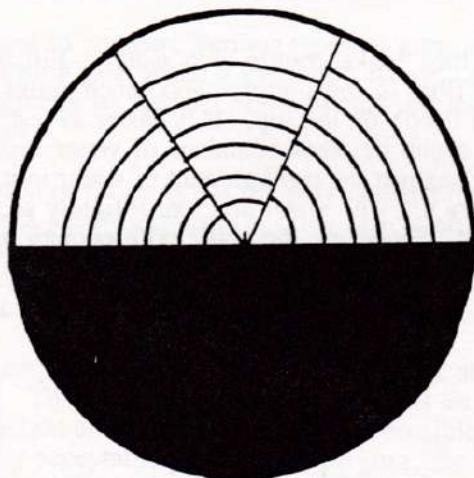


Figure 1

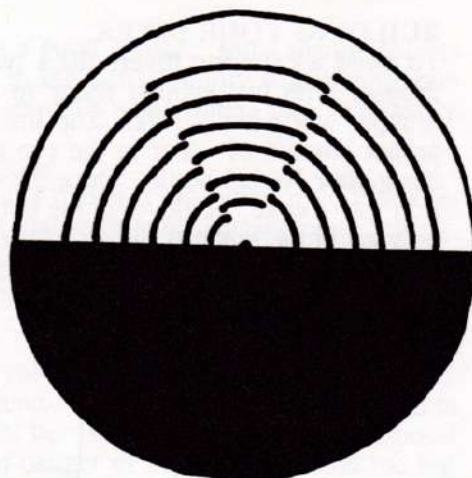


Figure 2

After constructing the disk, stick a thumbtack or straight pin through the center of the circle and attach the disk to the eraser end of an unsharpened pencil. Spin the pencil with your fingers and observe the various color patterns that appear. The wheel may also be designed to be placed on a turntable or attached to a variable speed electric drill for desired effects.

NOTES: The Color Illusion Wheel pictured above is only one of many possible variations that will produce the illusion of color. Students may wish to experiment with alternative designs which combine black and white backgrounds to produce other colors or patterns.

Some pizzas shops, which serve personal size pizzas, use precut cardboard disks. These disks are about six inches in diameter and are ideal for this investigation. You may wish to ask them for a donation for your class. This will eliminate any difficulties in cutting out disks.

Submitted by: Mel Fuller - University of Arkansas at Little Rock

CESI File Sheet 34

COUNCIL FOR ELEMENTARY SCIENCE INTERNATIONAL-NSTA DIVISION AFFILIATE

Mark and Meghan Twiest, Editors

CARTESIAN DIVER

MATERIALS:

1 two or three liter plastic soda bottle
1 eye dropper
water

You can begin this activity by demonstrating a diver you have already constructed. By holding the diver in one hand, use the other hand to pull an imaginary string that is tied to the eye dropper. As you pull this imaginary string, gently squeeze the bottle with your other hand. The students will quickly realize that there is no string. Once caught with this trick, you can confess that you actually were whispering and told the diver to sink. Demonstrate by commanding the diver to sink and gently squeeze the bottle.

Once your students catch you again, hand the diver over and ask them how it works. After they have learned how to make the diver sink, have the students make observations and suggest possible hypotheses as to why the diver sinks. Once this is done, you may begin having the students build their own divers to take home and amaze their parents.

BUILDING YOUR DIVER:

To build a cartesian diver, fill a two or three liter "coke" bottle with water. Fill the eye dropper with just enough water so that it will float in the bottle. Too much water in the dropper will make it sink. Too little will make it bob on the top. It is easier to test for the proper amount of water in the eye dropper, in a cup or other container of water instead of using your "coke" bottle. Once the eye dropper has just the right amount of water in it, place it in your "coke" bottle. Fill the bottle to the very top with water and seal it tightly so that the only air in the bottle is the air in the eye dropper. Squeezing the bottle with enough pressure will cause the diver to drop to the bottom. When the pressure is released it will rise to the top.



NO PRESSURE



PRESSURE APPLIED

Some Questions to Stimulate Thought:

1. Which is heavier, air or water?
2. What is happening to the water inside the eye dropper?
3. Why does the diver rise to the top when the pressure is released?
4. When the bottle is squeezed, the water transfers this pressure to the air in the eye dropper. What happens to the air's volume, pressure, and temperature?
5. You may find your diver at the bottom of the bottle in a few days, why?

CESI File Sheet 35

COUNCIL FOR ELEMENTARY SCIENCE INTERNATIONAL-NSTA DIVISION AFFILIATE

Mark R. Malone, Editor

CONSUMER TESTING IN ELEMENTARY SCHOOL (Chewing On Some Good Data)

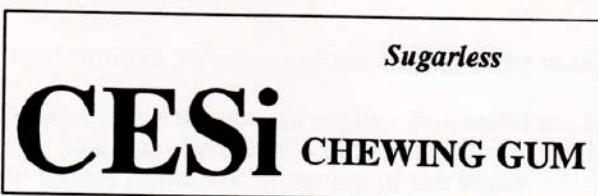
This activity is both true to the data gathering nature of science and quite tasty. Experience has shown that elementary students love science lessons that taste good. The purpose of this activity is to engage students in gathering real data about a question that may have some real importance to them. Each student will be given a stick of sugarless gum and be asked to chew it until the flavor is no longer acceptable. Students must record the time when they start chewing the gum and the time when the gum has lost its flavor. A good operational definition of flavor loss is when it is no longer acceptable to the student. An alternative operational definition could be when the gum no longer has any flavor. However, the latter definition might result in a lesson too long to fit into a single period.

The data can be compiled for the whole group on the graph sheet provided. Students may wish to compare various types of gum over several days to determine which holds its flavor longest. They may be particularly interested in testing claims of some gum manufacturers that their gums flavor lasts longer than other brands.

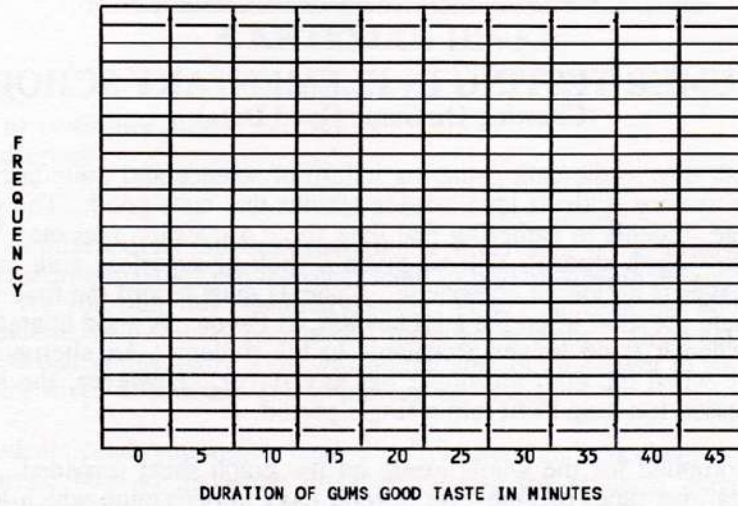
If trying to compare various types of gum, spearmint is a good choice. Most manufacturers of chewing gum make a spearmint flavor. Differences in the lasting ability of chewing gum vary greatly by brand. Some brands last less than five minutes while others may last nearly an hour.

Duration of flavor is not the only characteristic of gum that makes it desirable or undesirable. Students should brainstorm other characteristics of gum that may lend themselves to testing. Some possible suggestions are: preferred flavor of the class, preferred brand of the class in a particular flavor, cost per ounce, cost per ounce when duration is considered, bubble blowing characteristics of various bubblegums, etc.

You may also wish to discuss with your students the value of sugarless over sugar based gums. This might tie in well with a unit on dental hygiene. Personal social habits related to gum might also be discussed. Some possible topics might be: snapping gum, proper disposal, socially acceptable places to chew gum, the ever present danger of blowing a bubble too big and getting it stuck all over your face, etc.



CEWING GUM HISTOGRAM



CONSUMER DATA GATHERED ON GUMS TESTED:

Type of Gum Tested: _____

Flavor of Gum _____

Starting Time _____

Ending Time _____

Duration in Minutes _____
(Ending time minus starting time)

Submitted by: Mark R. Malone - University of Colorado

CESI File Sheet 36

COUNCIL FOR ELEMENTARY SCIENCE INTERNATIONAL-NSTA DIVISION AFFILIATE

Mark R. Malone, Editor

TWINKLE TWINKLE LITTLE STARS (I Know Exactly Where You Are)

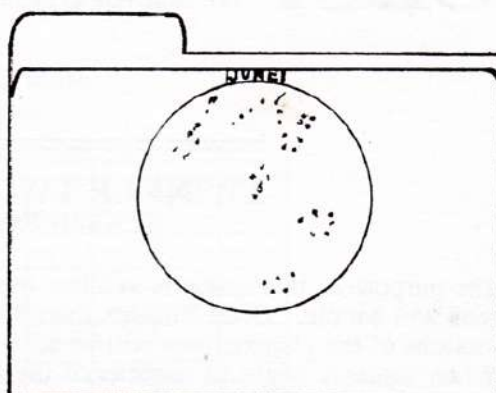
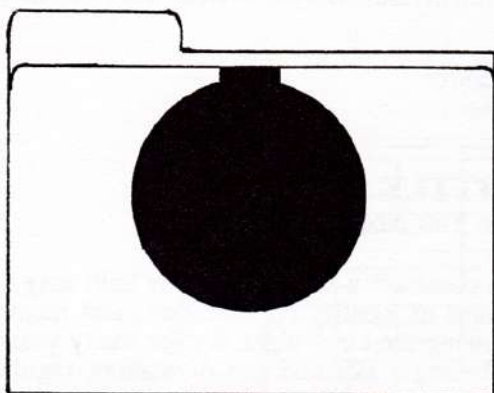
The purpose of this lesson is to allow the students to construct a star map that is both easy to read and handle. Once students learn to use star maps to identify constellations and record motions of the planets, they will be able to enjoy viewing the clear night sky for many years. When students begin to experience the beauty of the night sky and fun of making regular observations, they will be better able to appreciate many interesting celestial events such as comets, planetary movements, conjunctions, nova, meteors, aurora, and other phenomena. The circumpolar star map included in this activity is a good starting point to begin comprehending the movements of the night sky. Because the circumpolar stars are visible year-round, they can become familiar guideposts to exploring the night sky.

Materials for each student:

- 9 x 12 inch manilla folder
- Circumpolar Star Chart (photocopy from this file sheet)
- Brass Brad
- Star Chart (available commercially, most science supply houses, stores specializing in educational aids, and many book stores)
- Miscellaneous - scissors, drawing compass, ruler, staples, ruler, and pen

Construction

1. Cut out the star chart by carefully trimming along the outermost circle. You may wish to glue the star chart to a circle of stiff tagboard. The tagboard circle should be approximately the same size as the star chart (approximately 16 cm).
2. Draw and cut out a circle on one side of the manila folder. The circle should be approximately 13 cm in diameter. The outside edge of this circle should be positioned approximately 1 cm from the top and center of the folder. (See Figure 1)
3. Cut a slit at the top center of the folder. (See Figure 1) This slit should be just wide enough to read a single month at a time from the star chart (approximately 4 cm wide).
4. Place the star chart in the folder so that Polaris is at the center of the circle. If it is positioned properly, a single month should appear in the slit at the top of the chart. (See Figure 2)
5. Place a brass brad through Polaris to fasten the star chart to the back of the folder.
6. Close the folder and staple the outside edges. Be careful not to staple through any part of the star chart. The star chart should turn smoothly inside the folder. As it turns, the months will appear in the slot in the top of the folder.



Using the Circumpolar Star Map

1. Hold the map looking north with the month at the top.
2. This is the northern sky during that month at approximately 9:00 P.M. standard time.
3. The constellations shown will appear to move counterclockwise 15° each hour.
4. If you are viewing earlier than 9:00 P.M., turn the star chart clockwise 15° (one-half month) per hour. If you are viewing later than 9:00 P.M., turn the star chart counterclockwise 15° (one-half month) per hour.
5. This star map is most accurate at the middle of the month. If you wish to be more precise, you could shift the star chart half way between two months for viewing early or late in the month.

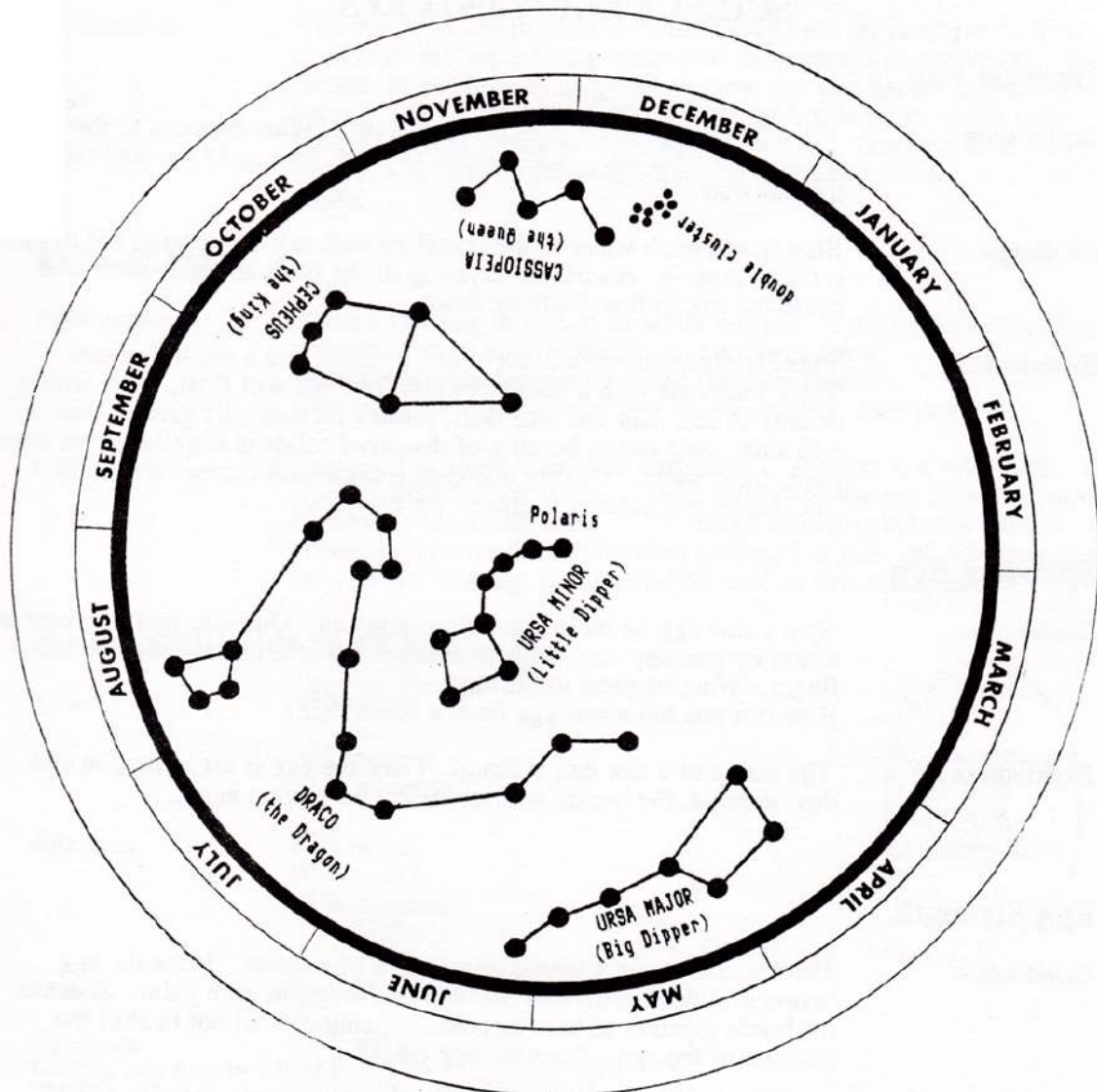
Using a Commercial Star Map

1. Set the dial so that the appropriate time and day are matched. (If your watch is set for daylight savings time, subtract one hour from the time.)
2. Hold the map in front of you and look south. This is the sky looking south at this time of day. The brad at the center of the star map represents Polaris which is behind you. Its height above the horizon corresponds to the degrees latitude at your location.
3. By simply inverting the star map, it can be used for viewing the northern sky. Students should be readily able to find the familiar circumpolar stars from the homemade star map.
4. Polar projections maps tend to be quite distorted near the outside edges. For this reason, most commercial star maps provide an alternative projections on the back for viewing stars in the extreme southern horizon with less distortion.

Tracking Planets

If students know which constellation a planet (or other celestial event) is in, they can use their star maps to locate them. These observations can be recorded by placing a small dot on the star chart indicating the location of the planet. By making these observations approximately once a month, the movement of the planet can be tracked. With careful observations they may even be able to observe subtle events like a planet's retrograde motion.

Circumpolar Star Chart



Submitted by:

Merrick A. Owen - Edinboro University of Pennsylvania

CESI File Sheet 37

COUNCIL FOR ELEMENTARY SCIENCE INTERNATIONAL-NSTA DIVISION AFFILIATE

Mark and Meghan Twiest, Editors

SCIENCE EGG-VENTURES

Floating Egg

Exploration

Place a raw egg into a glass of fresh water. What happens to the egg? Slowly add table salt. Add enough to cause the egg to rise and float in the salt water.

Challenge

Slowly add fresh water to the container with salt water so as not to mix it but to layer it. Successful layering of the fresh and salt water will cause the egg to float halfway down.

Explanation

Pure, fresh water has a mass of one gram/cc and a density of one. Those materials with a density of less than one will float; those with a density of less than one will float; those with a density greater than one will sink. Salt water, because of dissolved solids is slightly denser than pure, fresh water. Density becomes greater with increased salinity. The denser the water, the greater the buoyancy.

Spinning Egg

Exploration

Spin a raw egg on its side as fast as you can. Quickly, make it come to a stop by pressing on it with your finger. Then, quickly remove the finger. What happens to the egg?

How can you tell a raw egg from a boiled egg?

Explanation

The inside of a raw egg is liquid. Once the egg is set in motion and then stopped, the inertia will set the egg in motion again.

Egg Strength

Exploration

Place a raw egg in a plastic baggie as a precaution. Place the egg between folded hands with one end of the egg in each palm. Squeeze the hands together as hard as possible being careful not to shift the position of the egg. Does the egg crack?

Explanation

An egg's shape gives it great strength. The curvature of the egg distributes the pressure evenly rather than concentrating it at any one point.

Egg in a Bottle

Exploration

(The key to the success of this experiment is to obtain the proper size egg for the mouth of the bottle.) Twist a small piece of paper tightly. Light it with a match. While the paper is burning, drop it into a wide-mouth bottle. While the paper is still burning, quickly place a shelled, boiled egg, tapered end down, into the mouth of the bottle. A wet egg works best. Observe what happens to the egg.

Explanation

The egg is forced inside the bottle because the air pressure on the outside of the bottle was greater than the pressure on the inside. What caused the pressure to be greater? How can you get the egg out of the bottle? After clearing the debris from the bottle by swishing with water, hold the mouth of the bottle to the lips. Lean the head way back and blow as hard as possible. The egg should be forced out of the bottle.

Rubber Egg

Exploration

Place a raw egg in a glass of white vinegar. Cover completely with vinegar. Leave undisturbed for one to three days. What do you see happening in the first few hours? How does the egg look and feel after one day? Two days?

Explanation

Egg shell is 93-98% calcium carbonate. Vinegar is a mild acid. The reaction between the vinegar (acetic acid) and the egg shell (calcium carbonate) causes the shell to "dissolve" releasing bubbles (carbon dioxide). The membrane remains holding the yolk and albumen in tact. Do you see how egg shells could be used as fire extinguishers?

Nutritional Value of an Egg

Yolk	49% water
	31% fat
	16% protein
	1% minerals
Albumen	87% water
	10% protein
	1% minerals
	riboflavin
Shell	93-98% calcium carbonate

Egg by Weight
Shell 10%
Yolk 30%
Albumen 60%

References:

Teaching with Eggs by Alfred Devito

"Egg-Drop Contest" Pages 52-53 of *Inventors Workshop* by Alan McCormick

"Discover and Egg Carton" (Activity Cards) by Tin Man Press

Submitted by: Carolyn Blanding

CESI File Sheet 38

COUNCIL FOR ELEMENTARY SCIENCE INTERNATIONAL-NSTA DIVISION AFFILIATE

Mark and Meghan Twiest, Editors

MAKING A LIFE SIZE WHALE

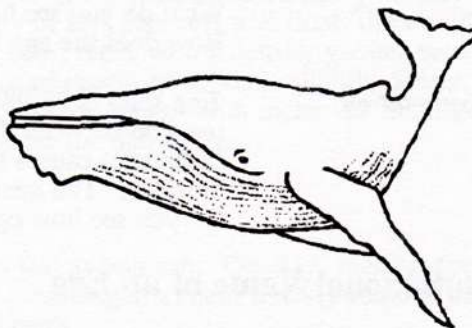
This activity is designed to give students an idea of how large a humpback whale actually is. Not only that, but your students will learn some characteristics common to these and other whales. Math relationships can be demonstrated by having the students make their own measurements from a picture and constructing the model from those figures instead of the ones given.

Strategy

Make a life size model of a whale using plastic and tape - like a Macy's balloon in the Thanksgiving parade. The whale can be kept inflated, like a plastic greenhouse, with a fan blowing continuously from one open end.

Materials

- 1 roll of industrial plastic, about 100 feet long (or 2/3 boxes of large plastic garbage bags)
- scissors
- wide plastic tape
- a large floor fan



Procedure

1. In a large open area (a hallway, basketball court, or gym), have the students draw a model of a whale using the measurements below. They can draw it on the floor using chalk or directly on the plastic.

Whale	Adult Size	
	m.	ft.
Sperm Whale	17	56
Humpback Whale	17	56
Pygmy Right Whale	06	20
Blue Whale	27	95
Pilot Whale	06	20

2. Cut two halves for the whale, four pieces for the flippers and two for the tail. Tape each separate part together before attaching the parts to the body. Leave the back of the tail open so that the fan can be placed there.
3. Tape the flippers and tail onto the main body.

4. The whale is now ready to be inflated. Put it in the gym or a large place inside if it is windy outside. If it is not windy, the whale can be blown up outside. Lay out the whale "balloon" in the open area. Place the fan in the opening of the tail and turn it on.
5. Mouth, eyes, and barnacles can be painted on the whale while it is blown up.
6. Have the students blow it up for other classes and teach the information they learned during the study of the whales.

Extensions

The extensions from this type of construction are unlimited. Students could construct many structures using similar methods. Here are just some:

- * a walk-in camera. Make an opening on one side of the camera which can be made larger or smaller to represent the pupil or aperture of the camera.
- * a planetarium. Punch holes in the cover to show the stars in the night sky.
- * a submarine. Students could take an underwater "trip" in the submarine with fish and other undersea animals hanging around the submarine. Clear plastic on the sides or for the entire submarine must be used.
- * a dinosaur. Students make a life size model of different dinosaurs.
- * small models out of garbage bags. Animals, organs, and systems could all be done in plastic bags and blown up with small table fans.
- * life size models or organs and organ systems.



Resources:

American Cetacean Society, PO Box 4416, San Pedro, CA 90731. This organization has excellent resources for teaching about whales at very reasonable prices, plus some freebie brochure material.

Submitted by: Rick Davis

CESI File Sheet 39

COUNCIL FOR ELEMENTARY SCIENCE INTERNATIONAL-NSTA DIVISION AFFILIATE

Mark R. Malone, Editor

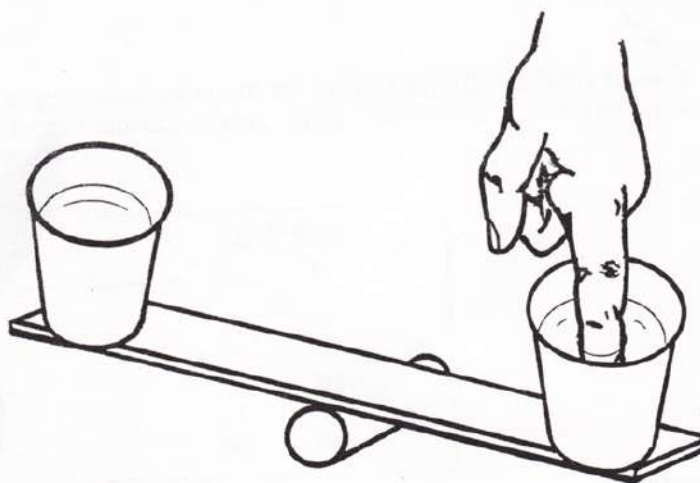
BUOYANT FORCE

Purpose: This demonstration provides a way of showing the force being exerted by water on objects placed in it.

Materials: two paper cups, dowel, water, finger

Directions: Balance the empty paper cups on the stick and fulcrum as shown in the drawing below. Place a finger in one of the cups without touching its sides. What happens? (Nothing) Now fill both cups with water and balance again. Place a finger into one cup again touching the water but not the sides of the cup. What happens? (The cup with the finger goes down.)

Explanation: The cup with the finger goes down because of the buoyant force pushing against the finger. As an object is lowered into a liquid it appears to weigh less because the liquid pushes up on the object. The force of the liquid on the object is called "buoyant force." Students have experienced the buoyant force when they have floated themselves or other objects in a swimming pool.



Submitted by:

Rita Fisher - Illinois State University

CESI File Sheet 40

COUNCIL FOR ELEMENTARY SCIENCE INTERNATIONAL-NSTA DIVISION AFFILIATE

Mark R. Malone, Editor

BUILDING SWEET THEORIES

Concept

Theories and hypotheses in science are based on evidence gathered objectively about the real world. Old theories are discarded if a newer theory is able to explain more about a phenomenon or event with fewer exceptions to the rules. A theory is not deemed to be "the truth" about a question but rather "the best explanation" based on objectively gathered evidence. Some people are troubled by the fact that science cannot prove anything absolutely. All theories are subject to change in the light of new evidence.

Many things in the realm of science cannot be studied directly but can only be studied by gathering indirect data or evidence. For example it is not possible to reach out and grab a piece of our sun or a star to analyze its composition. They are far too hot and much too far away for that to be possible. We can only gather information about them with telescopes, spectroscopes, and space probes. Other things are too small (such as the parts of an atom), too distant in time (like evolution of life), or too ephemeral (like an electron of electricity passing through a wire) to be directly observed. While this may be somewhat disconcerting, most things that we believe to be true are known only by indirect evidence.

The purpose of this lesson is to give students confidence in the nature of science by having them gather and interpret indirect data to verify the characteristics of a hidden object.

Materials (for each student or small group of students)

sugar cube
plastic party cup

piece of wax paper
rubber band

magic marker
data sheet

Construction

Use the magic marker to mark a dot on 0 to 6 sides of a sugar cube. You may wish to give each group a cube with a different total number of dots on it. Place the sugar cube inside of the plastic cup. Cover the top opening of the cup with four layers of wax paper. Be sure that enough wax paper is used so that a dot on the bottom of a sugar cube is visible (when the cup is held upside-down) but that dots on the side of the cube cannot be seen. Secure the wax paper over the cup with a rubber band.

Procedures

The purpose of this investigation is to have students identify an unknown through indirect evidence. They must determine how many sides of the sugar cube have dots without ever being able to actually see the whole cube at one time. They will then look at the sugar cube to see if a dot is visible or not on its bottom side. If a dot is visible they circle yes (Y) on the data sheet for the first trial. If no dot is visible they circle no (N) for the first trial. They should continue shaking and checking for 96 trials. After all data has been collected, students should total the number of yes responses and divide the total by 16. [Sixteen is used because it represents the total number of trials (96) divided by the number of sides on the cube (6)].

The dividend should be rounded off to the nearest whole number. This should be the total number of dots on the cube. Students should now open the cup to check whether their prediction was correct. With 96 trials their data will almost always indicate the correct number of sides unless they have made an error in gathering the data.

As a follow-up you may wish to have students work in pairs. One student may mark a cube and the other will try to predict the number of sides with a dot. They may then switch roles and repeat the activity.

As students gain confidence in this method of gathering data you may wish to explain that this concept of gathering evidence is just how scientists gather information about many theories and new discoveries. If you have cases where the data do not match the actual number of dots on a cube, you may wish to explain that errors can occur when scientists gather real data and that it is possible for them to make mistakes also. This is why scientists often repeat experiments to verify that what they have found is accurate and not just an anomaly.

Why Does It Work?

If you placed a dot on one side of the sugar cube and shake it in the cup, the chances of the side with the dot appearing are one in six. If you shake the cube and observe whether a dot appears six times, your chances of seeing it once are much higher, almost six in six. As a practical matter though, there is a chance that you will not see the dot at all and a chance that you will see it more than once. In this investigation it is necessary to see all six sides on the cube to predict how many sides have dots. The chances of shaking the cube six times and seeing all six sides is quite remote. The more times you shake the cube the greater chances of seeing all six sides. By shaking the cube in multiples trials of six, you are able to divide the total number of observations by the number of trials and predict how many dots are on the cube. As more trials are used, the chance of predicting the correct number of dots increases. The data sheet included with this file sheet requires 96 shakes or 16 trials. Actually, any multiple of six trials will work. Keep in mind, however, that the greater the number of trials, the greater the accuracy of the investigation. After students are familiar with this concept, they may wish to try to the investigation with more or fewer trials and see how the accuracy of their predictions is affected.

SWEET THEORIES DATA SHEET

1.	Y N	25.	Y N	49.	Y N	73.	Y N
2.	Y N	26.	Y N	50.	Y N	74.	Y N
3.	Y N	27.	Y N	51.	Y N	75.	Y N
4.	Y N	28.	Y N	52.	Y N	76.	Y N
5.	Y N	29.	Y N	53.	Y N	77.	Y N
6.	Y N	30.	Y N	54.	Y N	78.	Y N
7.	Y N	31.	Y N	55.	Y N	79.	Y N
8.	Y N	32.	Y N	56.	Y N	80.	Y N
9.	Y N	33.	Y N	57.	Y N	81.	Y N
10.	Y N	34.	Y N	58.	Y N	82.	Y N
11.	Y N	35.	Y N	59.	Y N	83.	Y N
12.	Y N	36.	Y N	60.	Y N	84.	Y N
13.	Y N	37.	Y N	61.	Y N	85.	Y N
14.	Y N	38.	Y N	62.	Y N	86.	Y N
15.	Y N	39.	Y N	63.	Y N	87.	Y N
16.	Y N	40.	Y N	64.	Y N	88.	Y N
17.	Y N	41.	Y N	65.	Y N	89.	Y N
18.	Y N	42.	Y N	66.	Y N	90.	Y N
19.	Y N	43.	Y N	67.	Y N	91.	Y N
20.	Y N	44.	Y N	68.	Y N	92.	Y N
21.	Y N	45.	Y N	69.	Y N	93.	Y N
22.	Y N	46.	Y N	70.	Y N	94.	Y N
23.	Y N	47.	Y N	71.	Y N	95.	Y N
24.	Y N	48.	Y N	72.	Y N	96.	Y N

_____ (Total YES) divided by 16 = _____ * (Number of dots on cube)

*Round off to the nearest whole number



Submitted by: Mark R. Malone - University of Colorado

CESI File Sheet 41

COUNCIL FOR ELEMENTARY SCIENCE INTERNATIONAL-NSTA DIVISION AFFILIATE

Meghan and Mark Twiest, Editor

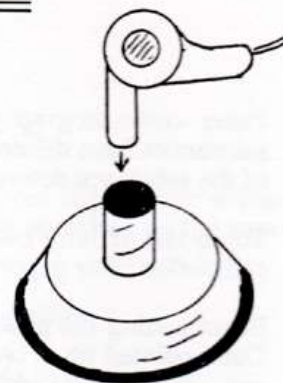
Hovercraft Construction

Here is a simple activity that teaches air related concepts:

- Air exerts pressure.
- Air exerts a force.
- Air does work.

MATERIALS:

- A disposable bowl (paper, plastic, or styrofoam)
- A paper towel tube
- Masking tape, scissors, pencil



PROCEDURES:

- Cut the paper towel tube into sections approximately 5 centimeters long. Be careful to avoid crushing it when cutting.
- Place one end of the paper tube on the center of the bowl and trace around the tube.
- Cut out the circle created on the bowl by tracing around the tube.
- Turn the bowl upside-down and insert the paper tube a few centimeters into the bowl.
- Use masking tape to fasten the paper towel roll securely onto the bowl. Be sure to seal all air leaks between the bowl and the attached tube.
- To make the Hovercraft float, simply blow into the top of the tube. A hair dryer can also be used as a source of air pressure.

EXTENSIONS:

- Students may want to increase or decrease the height of the tube.
- Try using different size bowls or modifying paper plates.
- Set up an obstacle course and have a race to see who can be first across a finish line.



Submitted by: Audrey H. Brainard - Georgian Court College

CESI File Sheet 42

COUNCIL FOR ELEMENTARY SCIENCE INTERNATIONAL-NSTA DIVISION AFFILIATE

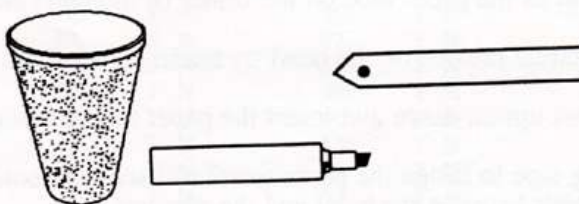
Meghan and Mark Twiest, Editor

PAPER CHROMATOGRAPHY

Paper chromatography is a method of separating substances from a mixture. Various substances have different attraction to paper. These properties along with the size and shape of the substance determine how far it will be carried by the paper before it is deposited.

To do this activity each student or group will need a cup, water, black water soluble marker and coffee filter paper or chromatography paper.

Begin cutting the paper into strips approximately one inch wide by four or more inches long. Cut a pointed tip at one end of the paper. Place a small amount of water in the bottom of the cup. With marker, draw a dot one inch from the tip of the paper point. Place the tip of the paper into the water. The water should remain below the black a dot with the dot remaining in the air. Allow the water to soak up the paper strip.



The black ink will separate into a rainbow of colors, each carried up the paper strip a different distance. These rainbow colored strips are called chromatograms and can be dried and saved. Try this same experiment with different colors and compare the results.

Other questions that your students can investigate include:

Does one color of marker move up the paper quicker than another?

Does the temperature of the water make a difference in the process?

Does the type of paper used make a difference?

Can you find other types of ink that separate other than magic markers?

Why doesn't the water continue to move up the paper?

A similar experiment utilizes a round piece of filter paper. Attach a wick at the center of the filter paper and place the other end of the wick into the water. A dot placed on the paper where the wick is attached will result in different colored rings on the filter paper.



Substances that are readily absorbed by the paper and not easily dissolved in the water solvent will travel the shortest distance. Those substances that are not readily absorbed by the paper and are easily dissolved in the solvent will travel the furthest.

Some words to add to your student's science vocabulary during this activity:

Absorption - The attachment of molecules in a thin layer to the surface of a solid.

Solution - A liquid containing a dissolved substance.

Solute - The substance that is dissolved in a solution.

Solvent - The substance in which a solute dissolves.

Submitted by:

Pam Cribbs - Coral Gables, Florida
Lynn Millikan - Miami, Florida

CESI File Sheet 43

COUNCIL FOR ELEMENTARY SCIENCE INTERNATIONAL-NSTA DIVISION AFFILIATE

Meghan and Mark Twiest, Editor

GO FLY A KITE!

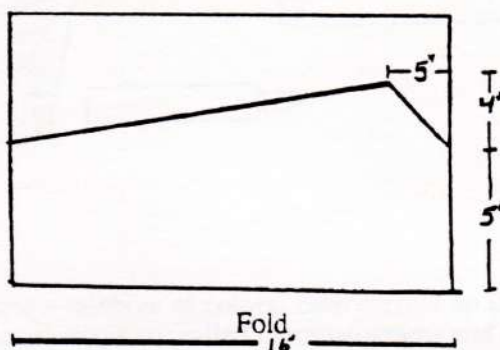
Attention Teachers! Now you can tell your students to "go fly a kite" and have a good excuse. All kids love kites, and kites can be a great motivator in the classroom. There is a design that is inexpensive, easy to make and a snap to fly. This design, the **Sled**, is just one of the many that you can make and fly with your kids.

MATERIALS:

- a white garbage bag
- strong tape (strapping)
- crepe paper
- a paperclip
- two 16" long plastic or wooden sticks
- kite string
- posterboard
- paper punch

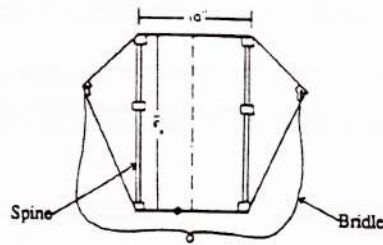
PROCEDURE:

1. Cut a pattern from posterboard using the dimensions shown in the diagram below. (It will look like half a kite.)



2. Place the pattern on the garbage bag with the longest edge on a fold. Draw around the pattern with a marker.
3. Cut carefully and evenly along lines you have drawn. (Do not cut along the fold.)
4. Open your sail surface and decorate it if desired with markers, spray paint, etc.

5. Place (spines) on decorated side of the kite. Tape sticks in place in three areas: top, bottom, and just above the center. (See diagram.)



6. Place a small piece of tape around each of the 2 side points of the kite and punch a hole through each with a hole punch.
7. Cut string for a bridle - 3 lengths of the sticks (48"). Attach a small paper clip to the middle of the bridle (onto which you will attach your fly line).
8. Tie bridle through two punched holes on points of kite.
9. Tape 2 identical crepe paper tails, one on each side, to the bottom. They should be three times the length of the spine. Attach fly line to paperclip and let 'er fly!

IDEAS FOR USING KITES IN YOUR CLASSROOM!

- Use kites when studying principles of flight, wind currents, or Bernoulli's Principle.
- Do research on different kinds of kites - the latest kite inventions, etc.
- Write kite poems.
- Integrate science with art by decorating your kite.
- Have a kite competition. Judge students' original kite designs in the following categories: most unusual, prettiest, best angle of elevation, smallest, largest, and best overall.
- You might require all winning kites to fly at least 100 ft. off the ground for at least one minute.
- Practice writing how-to directions for making your kite design and see if other can follow them.

For more information about kites, see articles in Science and Children, April 1980, and March 1987.

Submitted by:

Michelle A. Pedlow - State College, PA
Ken C. Mechling - Clarion University, Clarion, PA

CESI File Sheet 44

COUNCIL FOR ELEMENTARY SCIENCE INTERNATIONAL-NSTA DIVISION AFFILIATE

Meghan and Mark Twiest, Editors

STATIC ELECTRICITY & THE ELECTROSCOPE

The electroscope is a device that detects the presence of electrical charges.

Materials

large styrofoam coffee cup and lid	pocket knife
aluminum foil from a candy bar	plastic wrap
aluminum foil	balloon
paperclips - large	scissors
straight pin	tape
metric ruler	



Procedure

1. Line the inside of the styrofoam cup with aluminum foil.
2. Cut a 3 cm square window in the side of the cup with the top of the window about 4 cm from the top of the container.
3. Cover the window with plastic wrap and secure it with tape.
4. Open a large paperclip so it forms a "S."
5. Make a small hole in the center of the lid with the straight pin and suspend the S-hook through the hole so that the large end will be on the inside when the lid is placed on the cup.
6. Make the leaves of the electroscope from the candy wrapper by cutting two strips of foil about 1 cm wide and 4 cm long. Remove any adhesive or other matter from the foil.
7. Smooth and flatten the foil. Make a hole near the end of each strip so that the hole is a bit larger than the diameter of the paperclip.
8. Hang the leaves on the paperclip by these holes. The leaves must swing freely and not bind.
9. Place the lid on the cup. Charge the electroscope with a charged balloon and observe the forces between like charges.

Observations

1. What happens to the electroscope when the balloon is brought near the electroscope?
2. What happens when the balloon is withdrawn from the electroscope?
3. Explain the action of the "leaves" when the balloon is touched to the electroscope.

Conclusions

1. Static electricity is _____.
2. Like charges _____ each other, and unlike charges _____.
3. An _____ is a device that shows the behavior of static electricity.

Submitted by: Becky Trest - Houston, TX

CESI File Sheet 45

COUNCIL FOR ELEMENTARY SCIENCE INTERNATIONAL-NSTA DIVISION AFFILIATE

Meghan and Mark Twiest, Editors

PRIMITIVE LEAF PRINTS

Throw away the iron...throw away the crayons and dyes...and throw away that plain white paper. Here is a new and exiting way to make leaf prints. You can even begin a trend - primitive leaf prints. They are "the latest in fall fashion."

Begin making primitive leaf prints on white cotton cloth for practice. After students have an opportunity to practice, they can decorate their very own T-shirts. Designate a "Tree Awareness Day" for students to "show off" their creations.

Materials

wax paper (2 sheets per student)
scraps of white cloth (20 cm x 20 cm)
permanent cloth marker
spoons (1 per student)
cotton T-shirts (1 per student)
fall leaves

Procedure

1. Place a scrap of cloth on wax paper, position a leaf on the cloth, then cover the leaf with a second piece of wax paper. (Make sure every part of the leaf is covered.) Using the spoon, begin rubbing on top of the leaf, touching every part of the leaf. Remove the wax paper and leaf to determine the darkness of the print.
2. If you wish, you can draw in a tree, stems, or even write your name on your leaf print shirt, by using permanent marker.
3. To make your leaf print permanent, soak the shirt in a solution of one cup of salt in one gallon of water.



Some Helpful Hints

These leaves make exceptionally nice prints: red maple, sugar maple, and sweet gum.

Wet leaves work well. If you collect dry leaves, wet them with water and continue to keep them moist as you are making your prints.

Keep your collected leaves in a ziplock bag to avoid exposure to the air.

If you are using new T-shirts, wash them first.

When washing your newly printed T-shirt, keep it separate from other clothing.

You probably never thought you could design your own clothing. Well, here you have it, step-by-step instructions to show you how. The best part about it -- you are learning Science.



Submitted by: Denise DelGrosso - Riverside, CA

CESI File Sheet 46

COUNCIL FOR ELEMENTARY SCIENCE INTERNATIONAL-NSTA DIVISION AFFILIATE

Meghan and Mark Twiest, Editors

THE HUMMER - ZINGER

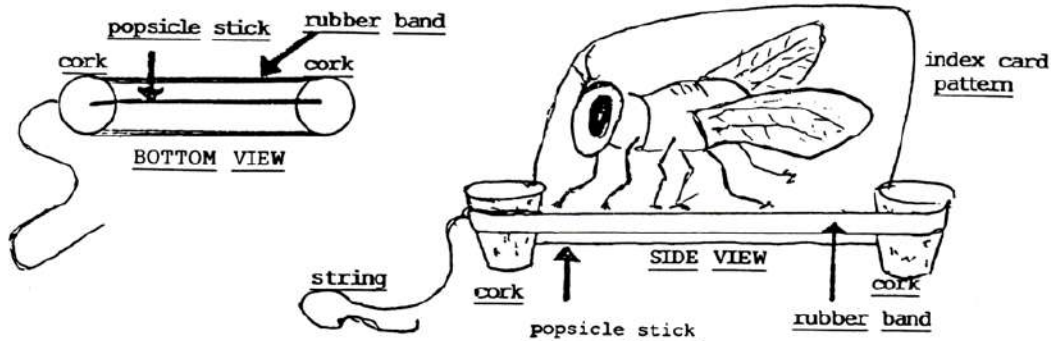
Look! Up in the sky! It's a bird! It's a plane! No, It's "Hummer-Zinger!!!" What's a "Hummer-Zinger" you ask? It's the perfect way to kick-off a unit on insects and at the same time introduce your students to abstract concepts about sound such as frequency, pitch, waves, intensity, volume, loudness, and vibrations.

Materials

two corks (size #2 or larger)
one popsicle stick
one rubber band (approximately 2 1/2" long by 1/4" wide)
one 3" x 5" index card
one Hummer-Zinger pattern
glue
scissors
coping saw or utility knife
string
markers or crayons

Procedure

1. Using the coping saw or utility knife, cut a lengthwise slit halfway through each of the two corks.
2. Squeeze a little glue into the slit of each cork.
3. Insert the ends of a craft stick into the slits and add additional glue. Stretch a rubber band around the corks, set aside until the glue dries.



DRAWING OF THE FINISHED PRODUCT

4. After it dries, have student tie a 70 cm string around one end of the stick. Place a small amount of glue on the string. Let it dry.
5. Allow students to practice twirling the Hummer-Zinger. It will make very little sound.
6. Tell the students they have to add something that flies. Have each student cut a piece of tagboard 10 cm long by 8 cm high. Have students decorate this with one of the "flying things" patterns or with a design of their own. Staple the decorated card to the stick.
7. To operate the Hummer-Zinger, twirl it around the head rapidly holding tightly to the end of the string. Caution the students to stand away from other people and objects while twirling their Hummer-Zinger.

How Does It Work?

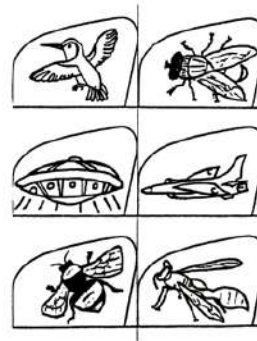
The source of the sound is a vibrating body. If you blow across a stretched rubber band, it will vibrate and produce a sound. As you twirl the Hummer-Zinger, air rushes over the rubber band, causing it to vibrate and thereby producing a sound. The tagboard rudder makes the Hummer-Zinger more stable as it is being twirled, thus creating a smoother air flow across the rubber band.

Extensions

Investigate the effects of the following:

- using different sizes of rubber bands
- varying the length of the stick
- varying the size of the corks
- using more than one rubber band

Have your class compose a "Hummer-Zinger" symphony



Submitted by: Sandra Goss - Montgomery, TX
Kathleen Pitrone -DuBois, PA
Ken C. Mechling - Clarion University, Clarion, PA

The Hummer-Zinger activity was adapted from Al Gunter's *Science Solutions*.

CESI File Sheet 47

COUNCIL FOR ELEMENTARY SCIENCE INTERNATIONAL-NSTA DIVISION AFFILIATE

Meghan and Mark Twiest, Editors

BUBBLES

Working for a way to demonstrate physical properties to students, it is hard to find anything as simple, inexpensive and fun to work with as bubbles. Bubbles can be used to demonstrate many physical properties including surface tension, pressure equalization, light refraction, and elasticity.

The composition of bubbles is a mixture of layers of hydrophobic and hydrophilic substances, creating the structure (surface tension) known as a bubble. The bonds formed in the mixture tend to contract. When inflated, the molecules expand or stretch (elasticity), forming a sphere (pressure equalization), as the tendency of the molecules to contract is offset by the force of the trapped air to expand. The stretched molecules refract light waves (refraction), depending upon the degree to which they are stretched.

Bubble Recipe

2 cups of water
1/4 cup of liquid detergent (Joy works well)
1/4 cup glycerine (corn syrup may be substituted)

Place the above ingredients into a container and stir well. Pour the bubble mixture into a shallow, flat-bottom pan. The soap mixture should be about 2 cm deep. (You can store the mixture in a closed container, such as a soda bottle, but be sure to shake it up well before using again.)

You will also need a bubble frame. To make a frame you will need: straws, string, and scissors. Use the straw to form 2 sides of a square frame and connect the ends with string to form the top and bottom of the square. After tying off the string, make sure you tuck the knot into one of the straws.

Tiny Bubbles

Now that the materials are assembled, it's time for exploration! Tell your students that you can make a window that can't be washed! Proceed to submerge the frame into the pan of bubble mixture and slowly lift it out. You should now have a window that refracts light but cannot be washed without popping it!

By taking the straws in hand, you can move the frame and the window back and forth without breaking or popping the window.

You may want to encourage the students to experiment with different maneuvers, including bringing the straw together to form a bubble.

Tell your students that you will now place your finger through a window without getting cut. This can be done by tying a string with a loop onto the middle of the top string of the frame. After submerging the frame into the mixture, slowly move your finger through the loop and then through the window. The resulting discrepant (unexplained) event is an eye-opening observation and activity for your students to perform!

All of these bubble activities can be used as demonstrations of activities that will prompt students to observe, infer, measure, predict, communicate and develop and use many other process skills.

References:

Allison, Linda and David Katz. Gee, Wiz!: How to Mix Art and Science or the Art of Thinking Scientifically, Covelo, CA: The Yolla Bolly Press, 1983.

Barber, Jacqueline, et al., Bubble-ology. Berkeley, CA: The Regents of the University of California, 1986.

Submitted by: John Bernardo, Buhl Science Center, Pittsburgh, PA
Patty George, Buhl Science Center, Pittsburgh, PA

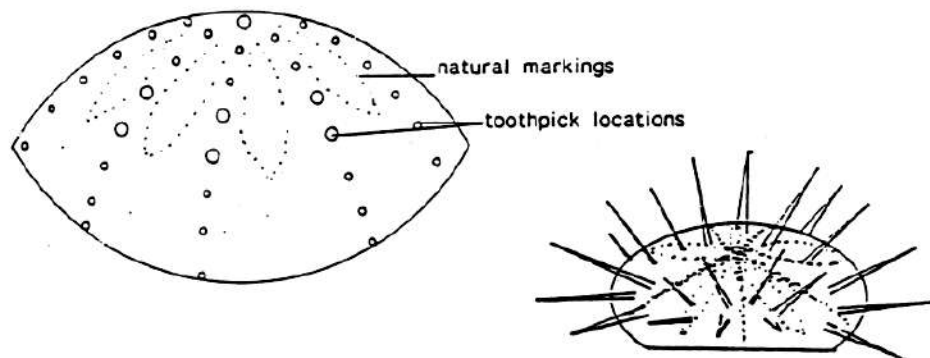
MONSTERS OF THE SHALLOW: THE SEA URCHIN

Materials

2 to 2.5 inch styrofoam balls, cut into quarter wedges with a serrated bread knife
purple tissue paper
scissors
toothpicks (round)
scotch tape

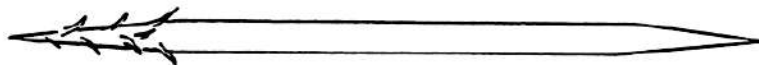
Instructions

1. Cut the styrofoam balls into quarter wedges.
2. Cut the tissue paper into approximately 6" squares.
3. Wrap the tissue around each of the styrofoam wedges, and tape down.
4. Pierce the styrofoam with toothpick spines. These look most effective when arranged as if to radiate from the center of a total urchin. See illustration below.



Barbed Spines of the Sea Urchin

Many sea urchins, especially poisonous species, have barbed spines. This can be demonstrated effectively in the following way. Use a razor blade or X-acto knife to cut small wedges into the tip of a toothpick as illustrated. Arrange some slightly untangled cotton or polyester fiberfill on the overhead projector, so that the fibers can be seen clearly. Insert an uncut toothpick into the mesh and withdraw it, noting that it does little or no damage to the fibers. Then insert the barbed toothpick into the fiberfill, and withdraw it, noting the difficulty in doing so. Discuss the advantages of having barbed spines for both offense and defense. What other animals have this adaptation? Can you find any plants with barbed spines?



Submitted by: Roxie Esterle

Mark R. Malone, Editor

BICYCLE SAFETY FOR EGG-HEADS

Jack and Jill

*Jack and Jill bike up the hill
To play with some friends from school.
If they fall down,
They'll save their crowns
They know wearing bike helmets is cool.*

Sincere apologies to Mother Goose for fracturing her classic nursery rhyme. Hopefully this fractured rhyme and a few broken eggs will help you make your students more aware of the need for added attention to bicycle safety. Sometime during the school year, many students plan to ride their bicycles to school. Bicycles give students hours of enjoyment and a sense of independence but, this pleasure and freedom are not without risks.

The statistics on bicycle riding are grim. Each year approximately 1200 bicycle riders are killed. An additional 80,000 are at least temporarily disabled and nearly 700,000 are injured. Although children between the ages of six and fifteen make up only one third of all bicycle riders, they are involved in over 78 percent of the accidents and 48 percent of all fatalities. Roughly 75 percent of fatalities are due to head injuries. Many of these tragedies could be avoided if the victims had worn bicycle safety helmets. Unfortunately the majority of riders, especially children, do not wear the protective head gear.

A bicycle safety helmet is a relatively simple device. It generally consists of one half inch of crushable but rigid foam surrounded on the outside by a hard outer shell. The crushable foam can absorb and minimize the impact while the outer shell protects the child from puncture wounds. When worn properly, the helmet should be fastened under the chin to prevent it falling off during an accident. Despite the helmets simplicity, it can prevent many types of head injuries.

Constructing a "Jack and Jill" Safety Helmet

Materials: (for the full class)

1 stapler
1 roll masking tape
markers, crayons, or other art supplies

Materials: (for each small group)

1 paper bathroom cup (90 ml - 3 oz)
2 or more hard-boiled eggs
1 piece of elastic tape (apx. 2 x 25 cm)
2 pieces of facial tissue
2 pieces of string (apx. 100 cm)
2 short segments of soda straw (apx. 3 cm)
2 toothpicks



Figure 1.

Preparing for the Crash

The lesson begins as an art activity in which students decorate several eggs to be used in the investigation. This part of the lesson is not essential but tends to give children a sense of commitment for caring about what happens to their eggs. Any design is acceptable for the eggs but representations of human figures such as Jack and Jill should help children relate what happens to the eggs in class to what can happen in real life situations. Because most eggs will eventually be broken during the activity, you may wish to avoid having students spend a great deal of time decorating the eggs.

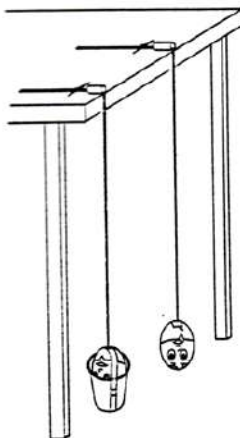
Construction of the safety helmet materials is really quite simple. With a little direction, students can assemble the parts quite easily. For younger students, you may wish to have parts cut to size before class to save time. The safety helmet is constructed by looping the elastic tape around the paper cup and stapling it on one side to form a loop around the cup as seen in Figure 1. (Stapling the elastic tape on one side of the cup only will later allow the students to easily place the tissues and egg inside the cup.) Next tie one end of the string to the elastic. Place the other end of the string through the soda straw section that has been taped to the edge of a table or desk. (See Figure 2.) Tie the toothpick in place, as shown, making sure that the cup just barely touches the floor.

Tape another egg to the end of another length of string. The other end of this string will be attached to a soda straw in the same manner as the safety helmet. Students will now lift the unprotected egg by pulling back on the string at increasing higher heights until the egg breaks. They may wish to experiment with dropping eggs in this manner from even greater heights to assess the damage done by the fall. A ruler can be held or taped near the egg to measure the height of various drops. You may wish to have students record the heights on paper or label the eggs by the height they were dropped from for comparison to protected eggs dropped later. Eggs will typically break when dropped in this manner at a height of approximately 5 to 10 centimeters.

Next student should crumple one or more facial tissues into the "safety helmet" (paper cup)g. They should use enough tissue so that the egg is held firmly in place by the elastic tape. The procedure of dropping the egg from increasing heights should be repeated with the egg in the safety helmet. Eggs dropped in this fashion will typical not break until dropped 40 to 60 cm or more. The relationship of the activity to real bicycle safety helmet and their use should be discussed after conducting the activity. Students should be encouraged to express their feelings about what happened to the egg and how it could relate to their choice of wearing or not wearing a bicycle helmet. You may also wish to have students relate the use fo the bicycle helmet to their use of skateboards, scooters, motor bikes, go-carts, etc.

(Note to preschool and primary teachers: You may wish to do this investigation as a side-by-side comparison rather than a data collection activity. This will enable students to explore the concept directly without the need of data gathering that may be beyond their current skill levels.)

Figure 2.



An Ounce of Prevention

While this activity emphasizes the value of safety helmets, students should be reminded that the best way to avoid being injured is by not being involved in an accident. Information and practice regarding safe bicycle operation can help avoid serious injury or worse. As a teacher you can develop a lesson which makes students aware of some of the most common causes of bicycle accidents. Some common causes of bicycle accidents are:

- Riding bikes into a roadway from a driveway or alley without stopping to look both ways.
- Riding down the middle of the street.
- Not being easily seen by motorists, especially at night. (Bikes should be equipped with reflectors, head and tail lights for night riding, and if possible, a fluorescent pennant. Riders should wear bright colors by day and white or light colors at night.)
- Riding the wrong direction on a roadway. (Usually against the flow of traffic.)
- Riding out into cross traffic.
- Failure to obey traffic signs or signals.
- Making unexpected turns without signaling.
- Colliding with car doors that open unexpectedly.

You can also help to make students aware of other aspects of safe bike riding. Bicycles should be kept in good repair and be periodically checked for: cracks in the frame, bent handlebars, broken spokes, bent wheels, worn tread or sidewalls. Seats, pedals, and brakes should be properly adjusted. Bicycles should also be equipped with a chain guard, pant clip, horn or bell, reflectors, and head and tail lights (for night riding). Guidelines for choosing the proper bike size and adjusting bikes to fit the rider are often available. Local bicycle shops or clubs are often good sources for information. Local police or fire departments sometimes offer programs to provide students with information and help them practice safe bicycle habits. These groups may be able to set up a practice field in your school parking lot.

As long as children (or adults) ride bicycles, there will inevitably be some unavoidable accidents. The dangers of these accidents can be minimized if the riders are wearing helmets. Why not take the lead in your school in preventing a potential tragedy? Perhaps you can interest your Parent/Teacher organization in working cooperatively with local merchants to make bicycle helmets available to students at a reduced rate. A letter sent home or an evening program for parents may also be helpful to inform them of the dangers of bicycle riding and the advantages of head protection.

References:

- Borse, W.H. (1980) Bicycle education in New 4-H for 8-11 year-olds. Kansas State University, Manhattan, KS (ERIC Document ED 183 319).
- Brown, M. & Krensky, S. (1982) "Dinosaurs, Beware! - A Safety Guide" Little, Brown and Company. Boston, MA.
- National Safety Council (1980) Accident Facts. National Safety Council.
- Rush, M. (1983) Bicycles: toys, transportation, threat to children. *Learning*, October.
- Wayne, J.E. (1982) Safety in the elementary school. Phi Delta Kappa Research Foundation, Bloomington, Indiana. Fastback 170. (ERIC Document ED 215 216).

Submitted by: Mark R. Malone - University of Colorado

Mark R. Malone, Editor

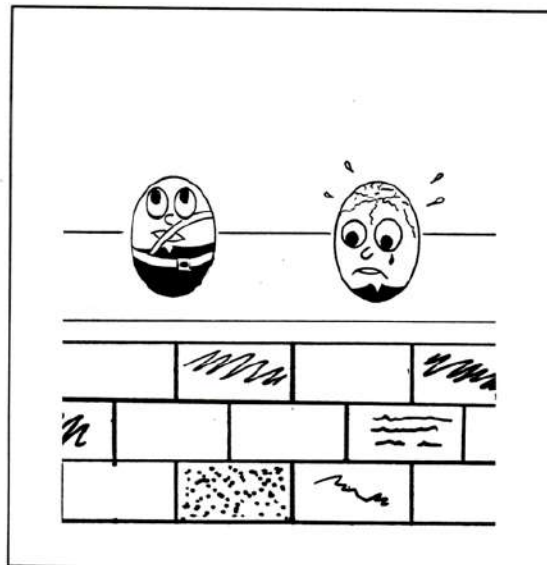
SEATBELT SAFETY FOR EGG-HEADS

The Mother Goose "Hit Squad" will be after me again as I fracture yet another classic nursery rhyme. Perhaps this fractured rhyme and a few broken eggs will help increase your students' awareness of the value of wearing seatbelts while riding in a car. The simple moral of this poem implies that a small bit of precaution can prevent a great deal of suffering and irreparable damage. When it is coupled with a concrete classroom activity showing how seatbelts work, it should aid in making students more aware of the importance of remembering to "buckle up" each and every time they ride in a car.

In our culture the automobile and automobile accidents are accepted simply as a way of life. Each year approximately 50,000 people in the United States are killed and many more are injured in motor vehicle accidents. The leading cause of death of elementary school children is automobile accidents. Each year nearly 3000 children between the ages of 5 and 14 are killed. An additional 150,000 of these youngsters are injured in automobile accidents. On the average, every American is involved in an automobile collision once every ten years. Of these accidents, one in twenty will result in serious injury. Sadly, 50 percent of the deaths and 55 percent of these injuries could be avoided if everyone would do one simple thing, fasten their seatbelts.

Humpty Dumpty

*Humpty Dumpty sat safe in his seat.
He fastened his seatbelt snugly and neat.
All King's horses
And all the King's men,
Will be glad to have Humpty back safely again.*



Why Seatbelts Work

An automobile accident results in two distinct collisions. The first collision occurs when an automobile collides with another object such as a tree or another automobile. In a typical 30 mile per hour crash the car comes to a rest in approximately one tenth of a second. This collision is quite visible and often quite dramatic. The second collision is more subtle but often even more damaging. It occurs within one fiftieth of a second after the first collision when an unbelted occupant, still moving at 30 miles per hour, collides with some part of the interior of the car. This collision is often with the dashboard, windshield, or steering wheel. The impact of this 30 mph collision is equivalent to jumping head first off of a three story building. As in the three story fall, one's arms are simply not strong enough to brace against the impact. Many children have a firmly held misconception that they could brace themselves as protection in an accident.

Seatbelts can prevent injuries and death in a number of ways. The seatbelt begins to stop the wearer as the car is stopping. This is known as "ride down" effect. There is distinct advantage to stopping in a tenth of a second over one fiftieth of a second. The seatbelts are also made of a webbed material that gives somewhat, adding slightly to the body's deceleration time. In addition, seatbelts keep the head and face from striking parts of the interior of the car, while spreading the stopping force of a collision over some of the stronger parts of the body such as the chest and hips. They also aid in keeping the occupants from colliding with one another or being thrown out of the car.

One common misconception often held by children and adults is that they may be safer being thrown out of a car than being in it when it crashes. They worry about being crushed inside the car or trapped in a seatbelt in a burning car. They may have had experiences or encounter other individuals who feel that they survived an accident because of being ejected from their vehicle. In rare cases this could be true; however, statistics show that a person is twenty-five times more likely to be killed if they are thrown from a car than if they remained inside. One could logically deduce from these statistics that for every person we encounter who has such a story of being saved by being thrown out of his vehicle, there are twenty-five others who are not alive to tell us how they were killed because they did not wear a seatbelt. Unfortunately, we never have the opportunity to encounter this silent majority. As far as the issue of being stuck in a burning vehicle, the experts say that we are better off even in this case because the occupants are more likely to stay conscious and be able to extricate themselves from a burning vehicle. An additional advantage of seatbelts is that in emergency conditions, the seatbelts can help the driver maintain control of the vehicle thus increasing the chance of avoiding an accident or additional collision.

Constructing Humpty Dumpty's Crash Vehicle

Needed Materials *(for the full class)*

1 stapler
1 bottle of wood glue
markers, crayons
miscellaneous art supplies

Needed Materials *(for each small group)*

1 block of wood (apx. 8 x 4 x 2 cm)
1 piece of pegboard (apx. 7 x 5 cm)
1 paper bathroom cup (90 ml - 3 oz)
2 thumbtacks
1 piece of elastic tape (apx. 2 x 20 cm)
2 or 3 facial tissues
1 piece of string (apx. 100 cm)
1 rubber band
1 heavy book
several hard-boiled eggs

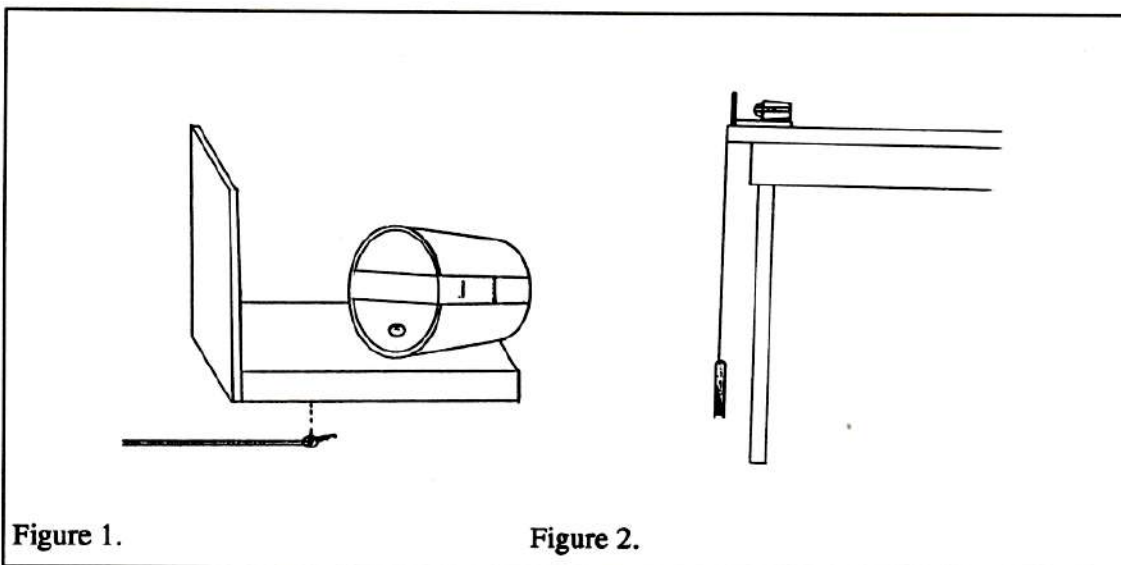


Figure 1.

Figure 2.

Preparing for the Crash

As in the previous issue of the CESI News of bicycle safety helmets, this lesson begins as an art activity in which students decorate several eggs to be used in the investigation. This part of the lesson is not essential but tends to give children a sense of commitment for caring about what happens to their eggs. Any design is acceptable for eggs but representations of human figures or Humpty Dumpty should help children relate what happens to the eggs in class to what can happen in real life situations. Because most eggs will eventually be broken during the activity, you may wish to avoid having students spend a great deal of time decorating them.

Constructing Humpty Dumpty's crash vehicle is relatively simple. For very young children or to save class time, you may wish to assemble the vehicles in advance. On the day prior to conducting the investigation the small piece of pegboard should be glued to the wooden block as shown in Figure 1. The pegboard can be temporarily held in place with a rubber band.

Next, wrap the elastic tape around the cup and staple it on one side as shown. Stapling the tape on only one side enables students to easily insert and remove eggs from the cup. After the glue has dried the cup should be fastened to the wood block with a tack. Another tack is used on the bottom side of the block to fasten a length of string. A heavy book should be tied to the loose end of the string as shown in Figure 2.

Investigating Humpty's Great Crash

The actual investigation compares eggs crashed wearing seatbelts with eggs crashed without the protection. Students should set up their crash tests by placing their desk or table near a wall. The book is left dangling over the edge of the desk as shown in Figure 2. The string should be just long enough to keep the book from touching the floor. The book is used to propel the crash vehicle across the table and into the wall. For tests with the seatbelt, a few facial tissues should be placed into the cup. Students should use just enough to assure that the elastic tape fits snugly around the egg holding it in place. Two or three tissues should generally be sufficient. Students should pull the crash vehicle back as far as the string will allow and then let go. The egg and vehicle should hit the wall. In most cases the egg will survive without even a crack. Next repeat the procedure with another egg but do not fasten the seatbelt. These eggs will suffer severe damage in most cases.

In some cases the protected egg will still suffer some damage. Use these anomalies to show that even seatbelts cannot protect against all injuries in all crashes. It is certainly always better to avoid being in an accident than trying to survive one. In any case the damage suffered by the protected eggs is almost always less than the unbelted ones.

Students should be given time to discuss the investigation and relate the experience to their own safety when riding in a car. Students are usually very surprised to see how much damage can be done in what seems to be a minor crash. The Humpty Dumpty activity is a good analogy for what can happen in a real automobile accident. Students seeing the damage in such a concrete fashion should enable them to make more informed choices regarding wearing seatbelts and encouraging other family members and friends to do so.

Putting Seatbelt Safety Into Practice

While this activity should create a concrete scheme for understanding why seatbelts work, it is another matter to create a lifetime habit of wearing seatbelts every time one rides in a car. Many individuals don't wear seatbelts or wear them only on long trips. Unfortunately most accidents happen within 25 miles of home not on long cross country trips. Putting the lesson into practice must ultimately involve the child's parents and family. One mechanism for encouraging seatbelt use is to establish a seatbelt club or reward system. In such a system, students and their parents keep track of the child's seatbelt use. A sticker chart is a good mechanism for keeping track of their progress. For each day that children use seatbelts every time they ride in their car, their parents give them a sticker or initial their chart. A certain number of points or stickers saved over time can be used to award a safety certificate or some other tangible recognition of the student's dedication to using seatbelts regularly. The student might even score additional points for encouraging others riding with them to fasten their seatbelts.

This investigation is designed to be fun and informative. It also give the classroom teacher an opportunity to influence the attitudes of their students and their students' families toward wearing seatbelts. The real payoff may come on the day a student returns to school alive and well after an accident in which the student and his or her family were wearing their seatbelts.

References

Borst, W.H. (1980) Bicycle education in New 4-H for 8-11 year-olds. Kansas State University, Manhattan, KS (ERIC Document ED 183 319)

Brown, M. & Krensky, S. (1982) "Dinosaurs, beware! A safety guide", Little Brown and Company. Boston, MA

But will they work? (1985) GEICO. Communications Department, GEICO Plaza, Washington, DC

Wayne, J.E. (1982) Safety in the elementary school. Phi Delta Kappa Research Foundation, Bloomington, IN. Fastback 170 (ERIC Document 215 216)

Submitted by: Mark R. Malone - University of Colorado

